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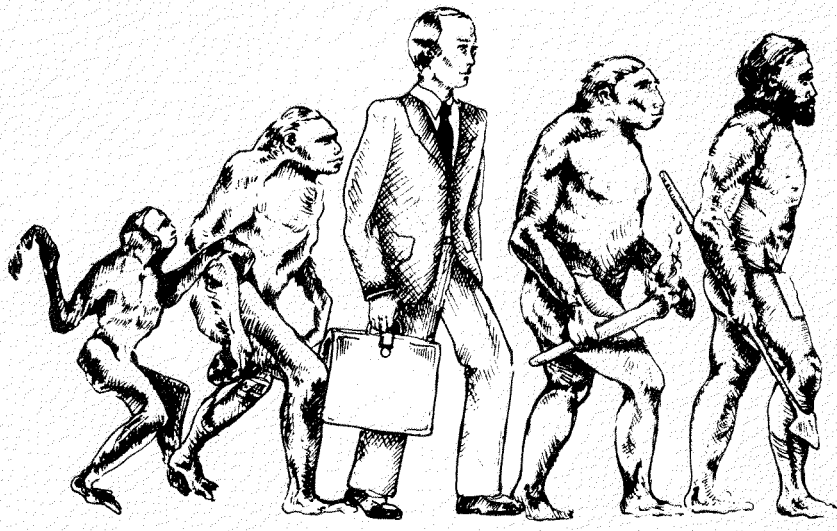

Are the fossils in the wrong order for human evolution?

Issue VIII **CONTENTS** **Spring 1982**

ARTICLES

1 Charles Darwin: A Centennial Tribute *by H. James Birx*
11 Kelvin Was Not a Creationist *by Stephen G. Brush*
14 Are There Human Fossils in the "Wrong Place" for Evolution *by Ernest C. Conrad*
23 Answers to Creationist Attacks on Carbon-14 Dating *by Christopher Gregory Weber*

REPORTS

30 Creation-Evolution Debates: Who's Winning Them Now? *by Frederick Edwords*
43 News Briefs

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FORTHCOMING PROGRAMS

PBS TV Program, "Creation vs. Evolution: Battle in the Classroom," airing Wednesday, July 7, at 9:00 PM Eastern time. This sixty-minute documentary explores the growing war of litigation over creationism in the public schools with interviews of teachers, scientists, religious, and political leaders, students, and parents in the forefront of the battle. The program particularly examines the "two-model" approach used recently in Livermore, California, and gets the reactions of the principal individuals involved. The basic ideas of creationism and evolution are argued in a "point-counterpoint" segment between Duane Gish and Russell Doolittle. The age of the earth and universe are covered. Other personalities featured include: Tim LaHaye; James Robison; Richard Bliss; Nell, Kelly, and Casey Segraves; John N. Moore; Bill Keith; and even Ronald Reagan. A featured representative on the evolution side is William V. Mayer. The documentary is a production of KPBS, San Diego.

1982 Annual Fellows' Meeting at Guilford College, August 8-13, Greensboro, North Carolina. Of the sixteen programs, one is entitled "Religion and Science: The Creationist Debate." Contact John O. Stevenson, Jr., 1501 Broadway, Suite 611, New York, NY 10036.

"Creationism in American Culture and Theology," October 9, at the Lutheran School of Theology at Chicago. Nine historians and theologians will respond to creationism at this all-day and evening symposium to mark the centenary of Darwin's death. Scientists, clergy, teachers of religion, school administrators, and other interested persons are invited. In addition to papers, new BBC films relevant to the controversy will be shown. The sessions will be taped. For details, contact: Dr. Richard P. Aulie, 6806 South Jeffrey Boulevard, Apt. 2G, Chicago, IL 60649, (312) 493-6328; or Dr. James S. Nelson, (312) 583-2700, ext. 436.

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Charles Darwin: A Centennial Tribute

H. James Birx

Because April 19, 1982, marked the centennial of Charles Darwin's death, it is appropriate that we summarize some of the compelling thoughts and recall the scholarly career of this outstanding naturalist. It was Darwin who revolutionized our factual understanding and rational appreciation of the origin and development of all life on earth (including the appearance and significance of our own human species). Darwin went further than any other naturalist both prior to and during his lifetime in presenting a comprehensive and intelligible synthetic explanation of changes throughout terrestrial space and time and of the mechanism which he thought responsible for them. As a result, we still continue to learn from and build upon his original insights. Unfortunately, there are many today who either misunderstand or misrepresent Darwin's thoughts. It therefore becomes necessary to correct many misconceptions in the process of explaining the ideas of this seminal intellect.

Before Darwin

In antiquity, several naturalist cosmologists speculated on the origin of life and man's position within the nature of things. Thales claimed that life first appeared in water, and Anaximander postulated that our ancestors had once passed through a fishlike stage in the early phases of life's development and movement from water to land. Xenophanes recognized both the biological and historical significance of fossils, while Heraclitus acknowledged universal change to be the essential characteristic of reality. Empedocles even anticipated the Darwin–Wallace basic explanatory principle of natural selection or, as Herbert Spencer referred to it, the survival of the fittest. In his bizarre attempt to account for the origin of those first organisms from the haphazardly coming together of free-floating organs on the surface of the earth at the beginning of life, Empedocles glimpsed the need for organisms to adapt and survive in order to reproduce and endure in a changing environment. In short, evolutionary ideas or concepts were implicit, if not explicit, in some early pre-Socratic speculations on the universe.

Aristotle, the father of biology and several other sciences, although he con-

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tributed to embryology and taxonomy, did not hold to an evolutionary interpretation of organic history. Strangely enough, he explicitly rejected the scientific value of fossils by claiming them to be mere random chance aberrations in rock strata. He even held that no living form of plant or animal had ever become extinct. One may argue that Aristotle in some cases supported the spontaneous generation of life from nonliving matter, but, for the most part, he claimed that the "Great Chain of Being" represented a terrestrial universe consisting of a static hierarchy of flora and fauna types. He likewise maintained that each kind of plant and animal had an eternally fixed natural place in this ladder of nature, which could claim the human animal, characterized by its greatest complexity of structure and degree of consciousness, as its apex. In no sense, however, did the Stagirite ever conceive of man as the end result of a dynamic process of antecedent organic development from lower to higher (that is, from earlier to later) forms.

Although the poetic natural philosopher Lucretius speculated on the evolution of the cosmos and the biosocial and cultural development of humankind, his incredibly modern ideas, formulated about two thousand years ago, were, until recently, overshadowed by the long predominant Aristotelianism and eclipsed from the general intellectual view.

In the Italian Renaissance, Leonardo da Vinci recognized the significance of fossil remains and anticipated at least geological, if not also biological, evolution. He boldly held the planet earth to be at least two hundred thousand years old! In general, however, the "Dark Ages," medieval period, and subsequent Renaissance contributed very little to biology as such, because of the concentration on theology, metaphysics, or astronomy that prevailed during those centuries.

Philosophers of the eighteenth century "Age of Enlightenment," however, returned to observing nature itself and critically reflecting upon human experience. At the beginning of that century, the eminent Swedish scientist, Carolus Linnaeus, fathered modern taxonomy. As a good Aristotelian, however, he was not an evolutionist, although he was bewildered, as a naturalist devoted to botany, by the discovery of varieties within some of those allegedly eternally fixed species he classified and described.

At the close of the 1700s and the beginning of the 1800s, the natural philosopher and invertebrate specialist, Lamarck, did uphold the evolutionary perspective. In fact, he was the first serious thinker to write a book solely for the purpose of presenting the theory of biological evolution as it applies to the history of the animal kingdom. In his major book, *Zoological Philosophy* (1809), Lamarck boldly presented his own arguments in favor of organic nonfixity and biological transformism. Although this volume appeared in the year of Darwin's birth and exactly fifty years before Darwin would publish his most important work on the theory of evolution, *On the Origin of Species* (November 24, 1859), Lamarck's controversial theory of organic history went unaccepted and unappreciated by the

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scientific community of the time. This was primarily because its explanatory principles were more metaphysical than naturalistic in character, such as his resort to spontaneous generation to account for the origin of the earliest plant and animal forms, his acceptance of the laws of use and disuse and the inheritance of acquired characteristics, and his vitalist interpretation of life—all rejected by modern science.

Darwin's Contribution

As Charles Darwin (1809–1882) modestly admitted, the idea of evolution did not originate with him. Yet, one may convincingly argue that Darwin is, in fact, the central figure in the history of the science of evolution. In spite of all those early insights, from Thales to Lamarck, it fell to him to bring together into a scientific and coherent view of life all the emerging facts and relationships in the embryonic sciences of historical geology, comparative paleontology, and developmental biology (including embryology and taxonomy). With the towering genius of Darwin, evolution ceased to be a mere rational speculation on nature or a philosophical overview on the scheme of things. It became instead an all-embracing scientific theory of organic history with explanatory, predictive, and exploratory powers. In short, evolution changed from being a philosophy to being a science.

It is interesting to note that, despite his early medical and theological studies, Darwin had no formal degree in geology or biology and, in fact, never taught these subjects at a college or university. Also, from our perspective and in the light of our benefit of hindsight, many of the very instruments he used in his scientific investigations were faulty. To his immortal credit, however, he always remained open and hospitable to the theoretical implications and physical consequences of his own experiences and experiments, as well as those of other naturalists. In short, Darwin's greatest teacher was the process of nature itself.

As a young naturalist, Darwin was primarily interested in historical geology and enjoyed collecting beetles and hunting as a sport. At that time, he never questioned his fundamental religious beliefs and accepted the then-taught doctrine of the eternity of plant and animal forms on earth. However, three major influences radically shifted Darwin's early conceptual framework from recent creationism to scientific evolution and caused him to become more and more interested in biology, and eventually general anthropology, while increasingly doubting the literal meaning of his youthful religious commitments.

The three major influences on Darwin's early thought were: the Hutton-Lyell geological theory of uniformitarianism, which advocated the slow but continuous evolution of the stratigraphic structures of the crust of the earth as a result of pervasive natural forces; the global scientific voyage of H.M.S. *Beagle* (particularly its five-week visit to the Galapagos Islands in 1835); and the chance

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but critical reading of Malthus's *An Essay on the Principle of Population* (1798). It is to Darwin's lasting advantage that he accepted the theory of geological gradualism and, as a naturalist aboard the *Beagle*, took full advantage of the opportunities for a vast range of experiences. During the *Beagle* voyage, Darwin became increasingly aware of the roles of camouflage and mimicry within the biological world, discovered giant prehistoric mammal fossils in Argentina, met the technologically primitive and nonliterate Fuegians at the tip of South America, witnessed the physical consequences of earthquakes, volcanic eruptions, and tidal waves on the malleable surface of the earth, and even found fossil marine specimens in rocks at the top of the Andes in Chile.

During the circumnavigation of the globe, the eccentric aristocrat and fundamentalist creationist, Captain Robert FitzRoy, encouraged Charles Darwin to collect empirical evidence in support of a literal interpretation of the story of divine creation as written in Genesis. However, to FitzRoy's displeasure and dismay, the more rocks and fossils Darwin studied and collected, the more convinced the young scientist became that the biblical account is not an adequate portrayal of the story of life. One might say that the creation-evolution controversy had its origin in the personal conflict that developed between FitzRoy and Darwin on H.M.S. *Beagle* during its historical journey around the world.

When Darwin returned to England in 1836, he was convinced that "descent with modification" had taken place throughout organic history. Yet, he still had no rational principle capable of empirical verification or falsification that would account for the origin of species on the earth. In 1838, a casual reading of Malthus's book gave Darwin the missing key to an understanding and appreciation of biological history in terms of evolution. According to the Malthusian principle of population, there is a discrepancy between the geometric increase in the number of organisms to be fed and the arithmetic increase in the growth of their food supply, resulting in pervasive struggle and ruthless competition in the living world. This principle gave Darwin his essential and useful explanatory device of natural selection or the survival of the fittest (today referred to as differential reproduction or extinction).

For many years, as a semi-invalid and quasi-recluse at Down House in the Kent countryside of England, the shy and gentle Darwin remained more or less isolated from the scientific community. He devoted years to empirical research, being dedicated to a vast array of subjects: orchids, climbing and insectivorous plants, the earthworm (his favorite animal), varieties of barnacles, the artificial breeding of cultivated plants and domesticated animals (especially pigeons), the origin of coral reefs and atolls, the formation of vegetable mold, and a comparative study of the emotions in nonhuman and human animals. Concerning the theory of biological evolution, Darwin merely sketched a thirty-five-page essay in 1842, which he later expanded into a 230-page manuscript in 1844. Despite continued urging and encouragement by scientific friends (notably Lyell, Huxley,

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and Hooker) to publish his already formulated theory of organic history, Darwin did not do so. In fact, he left provisions in his will for his wife, Emma Wedgewood, to see to it that the proposed multivolume work on evolution would be published in the event he should die before it appeared in print. One may even argue that Darwin had no serious intention of publishing a book on the theory of evolution during his own lifetime.

But, in the late spring of 1858, Darwin received a letter and manuscript from Alfred Russel Wallace. The event was to change the course of Darwin's life and the course of science in general.

Other Contributors

There are astonishing parallels between Darwin and Wallace: each was an English naturalist who had explored South America with interests in both geology and biology; visited an archipelago (Galapagos Islands and Malay, respectively); studied orchids and collected beetles; did original research on animals such as the barnacle and the butterfly; read Paley, Humboldt, and Lyell, as well as Malthus; enjoyed reflecting in solitude; accepted the scientific theory of biological evolution as a true framework of natural history; and indepedently founded the concept of natural selection as the primary explanatory mechanism to account for the emergence, survival, and extinction of life forms on earth.

Darwin had developed the principle of natural selection in 1838, but never published his views on the subject (the 1842 abstract and expanded 1844 version had not appeared in print). Wallace first presented a portion of his theory of evolution in two published works, *The Sarawak Law* (1855) and *Ternate Essay* (1858).

At the Linnean Society meeting on July 1, 1858, the Darwin–Wallace positions were read, and it was agreed that priority be given to Darwin as the scientific father of the theory of biological evolution by means of natural selection (although both Darwin and Wallace had independently discovered the significance of natural selection). It must be emphasized that Darwin had a much larger volume and array of documented empirical evidence and wider range of both experiences and experiments than Wallace had ever accumulated or could ever claim. Wallace, a meritorious and respectable scientist in his own right and an honest and grateful man, loyally conceeded the primacy to his friend Darwin.

As incredibly similar as these two naturalists were in 1858, in later years their interpretations of evolution increasingly diverged from each other to the point of eventual diametrical opposition. Whereas Darwin grounded his theory in mechanistic materialist terms, Wallace turned to spiritualism and argued that the essential uniqueness of the human being could not be accounted for merely through the accumulation of slight beneficial variations over long periods of time due to

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the process of natural selection alone. Darwin remained a rigorous naturalist throughout his entire life. His major one-volume work in evolution, *On the Origin of Species* (1859), appeared in the year following the arrival of Wallace's letter.

Darwin himself never defended evolution in public or in print. He left it to others to convince the scientific community, philosphers, and theologians of the validity and soundness of his admittedly disturbing interpretation of life on earth. Likewise, he did not at this time extend his view of things to account for the origin and historical development of the human species. (Nevertheless, anyone reading Darwin's *Origin* carefully could easily see its far-reaching implications for understanding and appreciating the organic history of the human zoological group as a whole.)

In 1860, the vertebrate paleontologist and natural philosopher, Thomas Henry Huxley, as "Darwin's bulldog," defended the theory of evolution against the scientifically uninformed and irrelevant arguments of Bishop Samuel Wilberforce ("Soapy Sam") in a public debate at Oxford University. Although reminiscent of the Darwin–FitzRoy personal conflict during the voyage of the *Beagle*, neither Darwin nor Wallace was present at the debate (nor were they present at the reading of their joint paper at the Linnean Society meeting in 1858). The Huxley–Wilberforce clash exposed the theoretically biased and scientifically faulty arguments of the special-creationist bishop. Wilberforce used arguments then that are still used by creationists today—namely that evolution cannot be established using the scientific method, that variation and natural selection are inadequate as a mechanism for macro-evolution, that mutation ("monstrosity") cannot be the source of advantageous variations, and that there are gaps in the fossil record and an absence of transitional forms. Huxley provided a learned and eloquent defense of Darwinism by answering Wilberforce's claims and by carefully building a case for evolution based on factual evidence. This debate enhanced the scientific credibility of the new theory and thus gave it its first major victory.

In 1866, the Czech monk, Gregor Johann Mendel, working with the common garden pea plant, *Pisum*, in the Augustinian monastery of Brno, discovered the basic principles of heredity. His pioneering research, incorporating rigorously controlled experiments and the use of mathematics, unfortunately went unappreciated by the other monks. Likewise, its value and significance went unrecognized by the scientific community at that time. There is no evidence that Darwin even knew of Mendel or ever read his monograph, *Experiments in Plant Hybridization* (1866). Had Darwin known of Mendel's discoveries, biology may have had the synthetic theory of evolution several decades earlier. Nevertheless, Mendel is properly acknowledged as the father of the science of genetics.

Like Haeckel in Germany, Huxley in England was quick to extend the theory of evolution to account for the origin and natural history of humankind. It was not Darwin but Huxley, in his book, *Evidence as to Man's Place in Nature* (1863),

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who first pointed out the striking and undeniable similarities between the great apes and humans. As a result, he claimed that the human species once shared a prehistoric common ancestry with its living pongid cousins.

In *The Descent of Man* (1871), Darwin finally joined Huxley and Haeckel in extending his own theory of evolution to explain humankind's place in biological history. However, by that time, this evolutionary battle had been generally won in scientific circles.

Early Problems

At first, the Darwinian theory of evolution had its shortcomings. At that time, the special sciences crucial for an empirical support of this conceptual scheme were not yet sufficiently developed. There were several important areas that caused Darwin trouble in presenting his theory, but the advances of science and natural philosophy in this century are increasingly modifying that theory, and only in a few instances have Darwin's own ideas needed to be rejected outright. It is surprising how enduringly valid Darwin's original writings still are in understanding and appreciating organic history on earth.

In Darwin's time, some physicists had greatly underestimated the age of our planet, claiming it to be merely about forty million years old. This presented Darwin with a problem, since it clearly did not offer enough time to account for the presumably gradual appearance of all of the plant and animal species that have ever existed on the earth. There was also the incompleteness of the fossil record itself (one may argue that fossil remains constitute the single most convincing body of evidence for the evolution of living things throughout natural history). It was also claimed that no living intermediate or fossil transitional forms are to be found in the geosphere or biosphere. However, absolute dating techniques in modern science clearly show that the earth is about 4.6 billion years old. The paleontological record continues to grow and includes specimens of so-called "missing links" which are transitional in nature between earlier and later taxonomic categories—for example, *Ichthyostega* the fishlike amphibian, *Seymouria* the amphibianlike reptile, *Archaeopteryx* the reptilian bird, and *Australopithecus afarensis* the pongidlike hominid.

Darwin's theory was also criticized because the origination of new species is not directly observable by human beings (although varieties or "incipient species" have been seen to appear on earth and not only under laboratory conditions). The Lamarckian influence on Darwin's own theory of pangenesis is no longer accepted by the scientific community. Unaware of the Mendelian principles of genetics, Darwin reluctantly had to fall back upon a particulate interpretation of inheritance, which did not distinguish between body cells (somatic cells) and sex cells (gametes). Darwin's hereditary units or gemmules were held to be

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produced directly by the various organs of a living body and, as a result, subject to use and disuse as well as the inheritance of acquired characteristics. This Lamarckian element in Darwinism was an attempt to account for the seemingly rapid evolution of life within a geologically short period of time.

Darwin's theory of descent with modification by means of natural selection stressed the struggle for existence among individuals and, as a result, underestimated the equally weighty and no less true elements of cooperation within a population as an aspect of group behavior (brought out in Kropotkin's study of such altruistic behavior patterns in his book, *Mutual Aid: A Factor of Evolution*, 1902). Today this phenomenon of cooperation is seen to be a crucial element in the preservation and evolution of some species, especially our own.

Darwin's gradualism did not allow for any sudden leaps or saltations in organic history. It assumed a rather smooth and uniform process of biological change. But today, with a better perspective on the fossil record, some paleontologists are adopting the Eldredge-Gould hypothesis of "punctuated equilibria." This is the view that the origin of new species is a more or less rapid process throughout organic history, taking often as little as one hundred thousand years. A number of intermediate steps do occur, as Darwin proposed, but these steps are telescoped together in this relatively short span of time (geologically speaking) and in small isolated populations. This explains the absence of many transitional fossils. However, because some fossil sequences are rather complete, Darwin's gradualism and the newer punctuated equilibria need not be seen as necessarily mutually exclusive mechanisms. In my opinion, both of these mechanisms have probably played a role in the origin of new species; thus, it might be proper to speak of "punctuated gradualism."

Modern Developments

The scientific evidence continues to support the theory of evolution. Neo-Darwinism or the modern synthetic theory of biological evolution is grounded primarily in random genetic variability and the necessity of natural selection (as such, Darwin's and Mendel's conclusions represent the essential features of the foundation of evolutionary biology in the last half of this century). There is, in fact, new and growing evidence that supports a broad application of the theory of evolution: astrochemistry and astrophysics support a process cosmology; historical geology supports continental drift (plate tectonics); recent hominid fossil discoveries shed light on the origins of humankind (such as the Laetoli footprints and the fossil material of *Australopithecus afarensis*); the emerging science of sociobiology points to the direct relationship between genetic inheritance and animal activity; biochemistry and systematics, as well as the recent research in genetic engineering, continue to support the historical continuity and essential

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unity of all living things on earth; and speculations in the emerging science of exobiology suggest that life may exist in many parts of our physical universe.

The latest studies in primate ethology demonstrate that, in terms of genetic makeup and behavior patterns, the human animal is closer to the great apes (orangutan, chimpanzee, and gorilla) than even Huxley, Haeckel, and Darwin had thought in the 1800s. Indeed, some scientists and natural philosophers argue that humans differ merely quantitatively rather than qualitatively from these three pongids.

It is apparent that, in the history of science and for ages to come, Charles Robert Darwin will undoubtedly continue to stand as one of the most fertile, powerful, and influential seminal intellects ever generated by our evolving species. The time-tested truth of the essential core of his theory of evolution, despite all the unavoidable modifications and corrections it has sustained and will continue to sustain in the future as a result of further advances in the sciences, cannot be ignored.

Just as the Bruno–Galileo conceptual revolution of the Italian Renaissance shifted the center of the universe away from our earth to elsewhere (be it the sun as with Galileo or the belief that reality has no fixed center and no fixed circumference as with Bruno), so the Darwinian worldview removes the attention from humankind as the special animal in the cosmos and makes possible the existence of evolving life and intelligence elsewhere in the material universe. To reject Darwin's theory altogether, as some misguided fundamentalists are urging us to do, would leave our species without a scientific compass upon the high seas of an unknown and highly problematic future, pregnant perhaps with wondrous opportunities but also with significant dangers.

We will undoubtedly continue to move ever further beyond Darwin—but never without him.

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Kelvin Was Not a Creationist

Stephen G. Brush

In their current efforts to persuade the public that their doctrine is a "science," creationists are seriously embarrassed by their failure to find any significant amount of support in the scientific community. Henry M. Morris, director of the Institute for Creation Research, has attempted to make up for the absence of reputable modern creationists by publishing a list of famous scientists of earlier centuries who were allegedly creationists. In his article, "Bible-Believing Scientists of the Past," he writes: "At least we creationist scientists can take comfort in the fact that many of the greatest scientists of the past were creationists."

Since Morris's list was used recently by two witnesses testifying in favor of a creation-science bill in the Maryland legislature and seems to be regarded by some people as evidence that creationism is not anti-science, it would be advisable to scrutinize its documentation. Unfortunately, Morris offers none at all in his article, although he claims to have compiled "biographical data concerning both their Christian convictions and their scientific contributions." His recently published book, *Men of Science, Men of God*, fails to provide the necessary documentation.

One might suppose that anyone who publishes the flat statement, "In each case, the scientists listed were strict creationists," would be prepared to provide supporting evidence. Not so. Dr. Morris was unable, when asked in correspondence, to give any creationist credentials for one of the most prominent scientists on his list.

The British physicist, Lord Kelvin (1824–1907), appears on the list four times, more than any other scientist, because he is credited with founding two disciplines—energetics and thermodynamics—and with making two notable inventions or discoveries—the absolute temperature scale and the trans-Atlantic cable. While the accuracy of some of these scientific developments may be disputed, there is no question that Kelvin was one of the outstanding physicists of the nineteenth century. But was he a creationist?

Kelvin did provide one strong argument against Darwin's theory of evolution: he estimated the age of the earth to be less than 100 million years, on the assumption that it has been cooling down from a hot molten ball with no internal generation of heat to replace that lost by conduction and radiation into space. Since Darwin had (somewhat carelessly) suggested that geological periods might

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last upwards of 300 million years, the impression was created that there had not been enough time for the slow process of evolution by natural selection to work. But there was nothing in Darwin's original theory that fixed a *rate* of evolution, and thus its validity did not depend on any particular time scale.

As is well known (to everyone except creationists), Kelvin's estimate of the age of the earth is much too small, because he was unaware of the presence of radioactive minerals that generate enough heat to replace most or all of what is lost. In any case, Kelvin's *lowest* estimate for the age of the earth was much more than a million years, so he cannot be counted a supporter of the creationist doctrine that the earth is less than ten thousand years old.

Nevertheless, it is not even true that Kelvin rejected biological evolution; he gave it qualified support and rejected creationism on at least one occasion. This was a presidential address to the British Association for the Advancement of Science in 1871. In this address, Kelvin asserted that life cannot arise from dead matter but can only proceed from life.

> How, then . . . did life originate on the earth? Tracing the physical history of the earth backwards, on strict dynamical principles, we are brought to a red-hot melted globe on which no life could exist. Hence, when the earth was first fit for life, there was no living thing on it. There were rocks solid and disintegrated, water, air all around, warmed and illuminated by a brilliant sun, ready to become a garden. Did grass and trees and flowers spring into existence, in all the fullness of ripe beauty, by a fiat of Creative Power? Or did vegetation, growing up from seed sown, spread and multiply over the whole earth? Science is bound, by the everlasting law of honor, to face fearlessly every problem which can fairly be presented to it. If a probable solution, consistent with the ordinary course of nature, can be found, we must not invoke an abnormal act of Creative Power. (Basalla, Coleman, and Kargon, pp. 125-126)

Having thus rejected the doctrine that life was suddenly created in its present form, Kelvin proposed instead that seed-bearing meteoric stones from another world started life on earth. He evaded the question of the origin of life on other worlds by postulating that such worlds of life have existed "from time immemorial."

Kelvin then accepted the hypothesis that present forms of life have evolved from these seeds:

> From the earth stocked with such vegetation as it could receive meteorically to the earth teeming with all the endless variety of plants and animals which now inhabit it, the step is prodigious; yet, according to the doctrine of continuity, most ably laid before the Association by a predecessor in this chair [Mr. Grove], all creatures now living on earth have proceeded by orderly evolution from some such origin. (p. 127)

Kelvin quotes part of the last paragraph of Darwin's *Origin of Species* (the famous "tangled bank" passage), adding that he sympathizes with the general

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idea of evolution but cannot accept the particular mechanism of natural selection proposed by Darwin. He mentions John Herschel's objection that this mechanism is "too much like the Laputan method of making books [by random combination of words] and that it did not sufficiently take into account a continually guiding and controlling intelligence. This seems to me a most valuable and instructive criticism. I feel profoundly convinced that the argument of design has been greatly too much lost sight of in recent zoological speculations." Thus Kelvin insisted that, while evolution may have occurred, it has been guided by the "intelligent and benevolent design" of a Creator (p. 128).

I conclude that Kelvin's views are precisely those now designated "theistic evolution"; by no stretch of the imagination can they be called creationist in the modern sense. I have asked Dr. Morris if he has any evidence that supports his claim that Kelvin was a creationist, in the light of the contrary evidence provided by the 1871 address. So far, he has been unable to supply any. I would therefore suggest that his entire list (with one exception) be treated with some skepticism.

Morris also argues that creationist beliefs did not hinder these great scientists in their scientific work. Of course this claim is vacuous until it is demonstrated that they actually were creationists. But in at least one case a creationist scientist *was* hindered by such beliefs. Louis Agassiz (1807–1873), the Swiss-American scientist who appears twice on Morris's list (as founder of glacial geology and ichthyology), was an outspoken opponent of evolution. His creationist views led him to misinterpret geological evidence in Brazil as showing Amazonian and hence worldwide glaciation. Such a global ice age would have severed all genetic relations between past and present life, he thought, and required that the present forms be specially created after the ice receded (Carozzi, 1973). Needless to say, this idea is not considered valid by modern glacial geologists—or even by modern creationists!

So Morris's efforts to show that creationist ideas are not a hindrance to scientific discovery seem to collapse when we examine the facts. Yet even if Morris had been right about all of his exemplars, unearthing these "creation scientists" from the past would prove nothing. Egyptians built the pyramids while thinking the earth was flat; Hypocrates knew nothing of the germ theory of disease; Kepler believed in astrology; and Newton practiced alchemy. Their ignorance and errors might not have hampered their major discoveries but might have prevented them from making others. Because they did not have access to the body of knowledge available today, we can understand their shortcomings. This same understanding, however, cannot be extended to modern-day creationists, who have no such excuse.

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Are There Human Fossils in the "Wrong Place" for Evolution?

Ernest C. Conrad

The scientific field of paleoanthropology, with its continuing discovery of more and more evidence for human evolution, seems to strike at the heart of the creationist interpretation of Genesis. It is not surprising, then, that creationists would make every effort to try to debunk the growing evolutionary tree of fossil hominids.

The creationist debunking effort is two-pronged. The first prong is to attempt to discredit the fossil finds of paleoanthropologists such as Richard and Mary Leakey, Donald Johanson, Tim White, F. Clark Howell, and Phillip Tobias. The second prong is to claim that evolutionary scientists conveniently leave out fossil hominid finds that don't fit into the evolutionary pattern. This article will concentrate on answering the second creationist argument, responding to the various hominid finds that creationists say upset the evolutionary chronology.

"Out of Place" Fossil Hominids

In the *Handy Dandy Evolution Refuter*, Robert Kofahl makes the following statement:

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> Fossil remains, the same or essentially the same as modern man, which were found buried deep or in strata dated very old, have been ignored and are no longer reported to the public. Examples are the Calaveras, Castenedolo, and Olmo skulls. (p. 73)

In *The Creation Explanation*, Kofahl, with Kelly Segraves, goes into more detail. After four pages of charts and diagrams, which include the above-mentioned three skulls together with some accepted by modern science, the book declares:

> . . . the Castenedolo, Olmo, and Calaveras fossils, all carefully documented, have been relegated to dusty museum closets and forgotten by the anthropologists because they do not fit into the accepted evolutionary scheme of human origins. Sir Arthur Keith, British scientist and dean of anthropologists in the first quarter of this century, in his book, *The Antiquity of Man*, described in great detail the Castenedolo, Olmo, and Calaveras fossils. He told how these fossils would have been accepted as genuine had they not so radically contradicted the ape-to-man dogma which rules the minds of most anthropologists. (p. 125)

Scientific Creationism, edited by Henry Morris, says much the same thing.

> For example, there were the Castenedolo and Olmo skulls found in Italy in 1860 and 1863, respectively. Both were identified as modern skulls and yet were found in undisturbed Pliocene strata. The Calaveras skull was found in California in 1886, also in Pliocene deposits, and it too was a fully developed modern skull. These were well documented at the time, but later became more or less forgotten. (p. 177)

The Bible Science Newsletter comments:

> Another example of how people react when the evidence does not agree with their philosophical position is the treatment which the Castenedolo skull received. This totally modern type skull was found in Pliocene strata, dated at one-half million years. Because this discovery did not agree with preconceived ideas, it is rarely mentioned in textbooks or other literature. (p. 5)

These creationists seem to be on to something, so let's investigate the existing data and examine each of these finds in more detail.

The Castenedolo

The *Catalog of Fossil Hominids*, edited by Oakley, Campbell, and Molleson, and published by the British Museum, states on page 235:

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> In 1860, G. Ragazzoni discovered hominid skeletal fragments on the hill of Castenedolo, but, since there was some doubt about their stratigraphical age, they were discarded as of no importance. In 1880, G. Ragazzoni found close to the site several hominid skulls with some associated post-cranial bones, including an adult female calvaria, fragments of parietal and occipital bones of an adult male, and isolated cranial fragments of a child.

This sounds impressive. Could creationists be right that these finds have been ignored? On page 107 in the 1957 issue of the classic, *Fossil Men*, by Boule and Vallois, we get our answer.

> The bones from Castenedolo, near Brescia in Italy, belong to several skeletons of men, women, and children and were found on various occasions in a shelly bed of sand and clay, of marine origin and of Pliocene age. In 1899, the discovery of a new human skeleton was the subject of an official report by Professor Issel, who then observed that the various fossils from this deposit were all impregnated with salt, *with the sole exception of the human fossils*. . . . It seems certain that at Castenedolo we are dealing with more or less recent burials. [Emphasis added]

This opinion was originally published before 1900. At present the Castenedolo materials are still in their original matrix and are located in the Instituto de Antropologia in Rome.

The investigation of the age of Castenedolo did not end with Professor Issel. As recently as 1965, newer and more sophisticated methods were applied to these materials. The *Catalog of Fossil Hominids* states: "Analysis of the bones showed that their residual collagen (assessed by %N) is higher than that of any other fossil bones from central and northern sites which have been tested" (p. 236). The end result of the collagen studies demonstrated that the Castenedolo materials were intrusive burials into the Astian clays. In 1969, the British Museum made radiocarbon tests on the cranial materials, and the tests demonstrated that the age was Holocene, the most recent life period (approximately twenty-five thousand years ago), and not Pliocene.

The Olmo

"Evolutionists generally ignore modern-type skulls which have been found in so-called ancient rock strata, because such discoveries do not fit their theories," says the *Bible Science Newsletter* (p. 5). "One such skull is the Olmo skull."

In the case of the Olmo materials, the creationists are in error from the beginning. The Olmo skull fits perfectly into the evolutionary chronology and is a legitimate specimen, for here we find a modern skull cap in upper-Pleistocene gravels—exactly where it ought to be. As G. G. MacCurdy states:

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> Professor Ignio Cocchi, who made the discovery in 1863 and who carefully studied the pieces as well as the site, referred all to the Lower Quaternary. . . . In 1897, Cocchi revised his opinion in regard to the Olmo cranium, referring it to the closing phases of the Quaternary [Pleistocene], a view which is no doubt more nearly in keeping with the facts. (p. 412)

The British Museum had developed a system and procedure for the relative dating of dentine, antler, and bone. The *Catalog of Fossil Hominids* describes it in this manner on page ix of the Introduction:

> This system combines fluorine analysis with uranium estimation by radiometric assay (expressed as equivalent urania, eU308, in parts per million) and nitrogen determination by microchemical analysis has often proved useful when there has been some doubt as to whether a fossil bone or tooth is contemporaneous with its matrix, derived from an older layer, or intrusive by burial from a younger horizon.

Based on this objective lab test of the Olmo skull, it was concluded: "Olmo 1 more probably from gravel, that is, upper Pleistocene" (p. 248). This would make it fifty thousand to seventy-five thousand years old, placing it in the Upper Paleolithic (Stone Age) cultural period.

The Calaveras

Although the Castenedolo find represented a simple burial in recent times and the Olmo was determined to be from Pleistocene strata, thus rendering both consistent with biological evolution, the Calaveras skull is a horse of a different color. It has turned out to be a deliberate hoax. Robert F. Heizer tells the story.

> The Calaveras skull, discovered in 1866, was one of the most notorious archaeological hoaxes perpetrated in the nineteenth century. J. D. Whitney, an eminent American geologist, had been appointed in 1860 to carry out a geological survey of California. A year before the skull came to his attention, Whitney had published his belief that man, mastodon, and the elephant had coexisted in California, and, perhaps for this reason, he saw the skull as an interesting bit of confirmatory evidence. Whitney believed the skull was authentic and considered it as a reliable example of Tertiary man. Later inquiry by Holmes in 1901 and Hrdlicka in 1907 produced evidence that the skull was a recent one, first found in a nearby Indian burial ground and then secretly taken into the mine (probably by one of the workers) and left there as a joke. The skull was taken by many to be evidence of a fully developed human type dating from the Pliocene. (p. 177)

Besides the later data, published in 1901 and 1907, which produced evidence that the Calaveras skull was indeed a hoax and a recent burial in the shaft, Thomas

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Wilson of Harvard University had run a flourine analysis on the skull in 1879. His results showed it to be recent and intrusive as well. The hoax became so well known that in 1899 Western humor writer Bret Harte wrote a satirical poem, "To the Pliocene Skull."

However, as noted by Christopher Weber, creationists are still using Calaveras Man to show the duplicity of paleoanthropologists. But duplicity seems to be on the other foot! Weber writes:

> In the light of this data, it is strange that standard creationist works like Henry Morris's *Scientific Creationism* (p. 177), Robert Kofahl's *Handy Dandy Evolution Refuter* (pp. 78–79), and Kofahl's and Segraves's *The Creation Explanation* (pp. 120–125) still take Calavaras Man seriously. . . . On the other hand, these same authors never let evolutionists forget the Piltdown hoax. (p. 21)

And isn't it interesting that creationists cite Sir Arthur Keith as a supporting authority for their claims about the Castenedolo, Olmo, and Calaveras fossils, but ignore the fact that Keith also accepted Piltdown. Though Keith was truly *the* big name in human evolution in his day and showed proper scientific caution about these fossils, physical anthropology was in its infancy then. It is to be expected that new sciences often fail to get things right the first time. With experience, new tools, and new methods, however, physical anthropology has come a long way in recent years.

Homo Erectus

Another fossil hominid that creationists say is in the "wrong place" for evolution is the well-established *Homo erectus*. In this case, they don't try to claim that the fossils are getting dusty in museum closets because scientists are conveniently forgetting about them. Creationists instead imply that it is something of a "club secret" among scientists that *Homo erectus* doesn't fit properly into the evolutionary chronology and, in fact, isn't even ancestral to modern humans. Scientific reports about *Homo erectus*, creationists contend, show significant problems. Robert Kofahl declares on page seventy-six of the *Handy Dandy Evolution Refuter*: "When carefully compared, these reports show that Peking Man [*Homo erectus pekinensis* or *Sinanthropus pekinensis*] was an animal, probably a large monkey or baboon, not a man." It would seem from this that physical anthropologists have no knowledge of human, monkey, and baboon morphology and have never heard of multivariate analysis or biometrical studies. (Such an implication renders the creationist comment absurd.) But Kofahl goes on to say: "Later, Marcellin Boule, international authority on fossil skulls, made a careful study of the bones and the site and published his conclusion that *Sinanthropus* was an

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animal which was eaten by the true men who had manufactured lime at the site." In regard to this statement, Professor H. Vallois, past director of the Institut de Paleontologie Humaine in Paris, France, informs me that Professor Boule wrote only one paper about the *Sinanthropus.* It was published in the 1937 issue of *L' Anthropologie* (p. 1). In this article, Professor Boule only considers that the *Sinanthropus*, a close relative of the *Pithecanthropus*, belonged to a group which had many of the characteristics of the big apes *but was most certainly human.* It may be noted that Professor Vallois was a close colleague of Professor Boule.

The famous French human paleontologist and Catholic priest, Henri Breuil, expresses himself as follows:

> *Sinanthropus* kindled fire and did so frequently; he used bone implements and he worked stone, just as much as the Palaeolithics of the West. In spite of his skull, which so closely resembles that of *Pithecanthropus*, he was not merely a Hominian but possessed an ingenious mind capable of inventing and hands that were sufficiently master of their fingers to fashion tools and weapons. (Boule and Vallois, p. 144)

Teilhard de Chardin and the Chinese paleontologist, W. C. Pei, who both worked the site, concluded:

> All the positive facts so far ascertained tend to give us the conviction that *Sinanthropus* is the Hominid who kindled fires and dressed the stones in the cave at Choukoutien. (Boule and Vallois)

But creationists have tried to do more than just make a monkey out of *Sinanthropus* (*Homo erectus*). All this was just a lead-in to their main point about its position in the evolutionary chronology. They base their argument on an interpretation of the relevant fossil finds from Australia.

In the October 1972 *Scientific American*, a brief note was made of the discovery in the Kow swamps of Australia of some ten-thousand-year-old cranial materials. The discussion consisted of three long paragraphs, from which the creationists quoted forty-three words in *Scientific Creationism* (Morris, p. 174).

> Skulls that were buried a scant ten thousand years ago now suggest that, at a time when elsewhere in the old world the successor species, *Homo sapiens*, was turning from hunting and gathering to agriculture, some *Homo erectus* genes lingered on in Australia.

The creationist conclusion from these forty-three words is:

> These *Homo erectus* skulls found in Australia show that modern man had already been in existence long before, ruling out *Homo erectus* as a possible ancestor; he is more likely a decadent descendant.

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This is a classic non sequitur (as well as being a claim that disagrees with Kofahl's view that *Homo erectus* was a monkey or baboon).

The conclusions of the Australian prehistorians in the third paragraph of the same *Scientific American* discussion (page forty-eight) was for some reason overlooked by the authors and editors of *Scientific Creationism*:

> Thorne and Macumber suggest that the overall skull form includes archaic features that preserve *almost* unmodified the morphology typical of *Homo erectus* fossils from Java, *combined* with elements of early representatives of *Homo sapiens*. . . . The archaic skulls represent isolated remnants of an even earlier population. [emphasis added]

It appears, as expected in an isolated continent such as Australia, that some *Homo erectus* genes lingered on. *This does not say that what lingered on was* Homo erectus. "Ruling out" state the creationists; "isolated remnants" say the Australian scientists. It appears obvious why the total article was not quoted.

The conclusion reached by Professor Rhys Jones of the Australian National University is:

> Either there were two populations, an ancient archaic one being added to or partially replaced by a modern one which entered the continent some time before twenty-five thousand years ago, or the founding population itself showed marked polymorphism, perhaps due to hybridization in the region of embarkation. The first solution, which seems the most likely at present, also implies that a great slab of Australia's prehistory still awaits discovery.

To make certain that I was on the right track and was reading the materials objectively, I wrote to scientists at the Australian National University in Canberra, who subsequently informed me:

> The ten-thousand-year-old Kow swamp crania *are not H. erectus* nor do they quite fit with the Neanderthal vintage early *sapiens* skulls from Wadjak and elsewhere in Southeast Asia. But they are extraordinarily robust and show a number of archaic features that seem to harken back to an early breeding line going back through Wadjak to the *H. erectus* populations of Pleistocene Java.

What we may have with the Kow crania is not a ruling out of *Homo erectus* as an ancestor but rather a remnant group showing extreme polymorphism due to population mixture. The creationist misuse of the sources is typical of their usual manner in dealing with the evidence for human evolution.

Recent Finds

In the November 1981 *Impact*, published by the Institute for Creation Research,

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Gary Parker states, ". . . We have evidence that people walked upright before Lucy was fossilized—the Kanapoi hominid, Castenedolo Man, perhaps even the Laetoli footprints discovered by Mary Leakey . . ." (p. iii). He uses this material as support for his contention that Lucy could not have been our ancestor because "people" were around earlier. But let's look at the facts.

The Kanapoi material was discovered on an exposed erosion slope near Telek's volacano at the south end of Lake Rudolf in East Africa. The find was made by Dr. Bryan Patterson in 1965 while working with the Harvard University Museum of Zoology. This hominid discovery consisted of KP 271, a single elbow fragment (the distal end of the humerus). The specimen has been dated by faunal evidence and on correlation with Mursi (yellow sands) in Omo Valley at between 4 and 4.5 million years in age. Physical anthropologists are not jumping to any rash conclusions about this find. In general, the feelings are that the Kanapoi discovery is too fragmentary to allow much elaboration. Donald Johanson states in his book, *Lucy: The Beginnings of Humankind*, that the Kanapoi find is "so fragmentary, so worn, so lost in the wastes of time" that there is nothing it can tell us "beyond what logic could have said anyway: that some kind of ape into hominid was developing in East Africa during that period" (p. 361).

As for the Laetoli footprints, they tend to support evolution and counter the arguments of those creationists who doubt that Lucy and other Australopithecines walked upright. Richard Hay and Mary Leakey, writing in the February 1982 *Scientific American*, noted that the Laetoli footprints date back between 3.5 and 3.8 million years. Lucy has been dated at about 3 million years old. Therefore, if the footprints at Laetoli in Tanzania, Africa, were made by *Australopithecus afrensis*, this merely shows that there was a period of stasis in the evolution of that hominid type lasting at least five hundred thousand years. There is nothing strange about that.

The hominid footprints at Laetoli were found in 1977 and 1978. Hay and Leakey declare:

> The best-defined of the footprints are from one centimeter to three centimeters deep and have clear margins. They show the rounded heel, uplifted arch, and forward-pointing big toe typical of the human foot. . . . The hominid tracks are clear proof that 3.5 million years ago these East African precursors of early man walked fully upright with a bipedal human gait. This was at a time when, both in stature and in brain size, the hominids of Africa were still small by later human standards. (p. 56)

The estimated height of these hominids averaged around 1.4 meters (four feet, seven inches).

Parker's comments that imply that these footprints must be in the wrong place for evolution are no more logical than saying that, because my great, great grandfather walked erect, he could not have been my ancestor. All the Laetoli

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prints do is push back further into time the origin of hominids. When Parker says "we have evidence," he should note that evidence is the data upon which a judgment or conclusion can reasonably be based or by which proof or probability can be established. But the evidence of KP 271 and the Laetoli footprints fail to lend support to Parker's conclusion that Lucy could not have been our ancestor.

Conclusion

The creationist interpretations and comments on those human fossils that are supposedly in the "wrong place" for evolution are nothing less than pseudo-scientific notions based on a need to defend biblical inerrancy. These notions constitute a collection of outdated information and views, unwarranted projections, and discarded hypotheses. Put into scientific guise, they do nothing to shake the "establishment" position that humans are a product of an evolutionary process. If the creationists had really established the truth of their numerous statements in the field of paleoanthropology, this indeed would have been an astonishing upset. And contrary to what creationists may lead people to believe, any firm evidence they had would have found a welcome place in the standard scientific journals. As it is, creationists have simply failed to make a case.

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Answers to Creationist Attacks on Carbon-14 Dating

Christopher Gregory Weber

Radiocarbon dating can easily establish that humans have been on the earth for over twenty thousand years, at least twice as long as creationists are willing to allow. Therefore it should come as no surprise that creationists at the Institute for Creation Research (ICR) have been trying desperately to discredit this method for years. They have their work cut out for them, however, because radiocarbon (C-14) dating is one of the most reliable of all the radiometric dating methods.

This article will answer several of the most common creationist attacks on carbon-14 dating, using the question-answer format that has proved so useful to lecturers and debaters.

Question: How does carbon-14 dating work?

Answer: Cosmic rays in the upper atmosphere are constantly converting the isotope nitrogen-14 (N-14) into carbon-14 (C-14 or radiocarbon). Living organisms are constantly incorporating this C-14 into their bodies along with other carbon isotopes. When the organisms die, they stop incorporating new C-14, and the old C-14 starts to decay back into N-14 by emitting beta particles. The older an organism's remains are, the less beta radiation it emits because its C-14 is steadily dwindling at a predictable rate. So, if we measure the rate of beta decay in an organic sample, we can calculate how old the sample is. C-14 decays with a half-life of 5,730 years.

Question: Kieth and Anderson radiocarbon-dated the shell of a living freshwater mussel and obtained an age of over two thousand years. ICR creationists claim that this discredits C-14 dating. How do you reply?

Answer: It does discredit the C-14 dating of freshwater mussels, but that's about all. Kieth and Anderson show considerable evidence that the mussels acquired much of their carbon from the limestone of the waters they lived in and from some very old humus as well. Carbon from these sources is very low in C-14 because these sources are so old and have not been mixed with fresh carbon from

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the air. Thus, a freshly killed mussel has far less C-14 than a freshly killed something else, which is why the C-14 dating method makes freshwater mussels seem older than they really are. When dating wood there is no such problem because wood gets its carbon straight from the air, complete with a full dose of C-14. The creationists who quote Kieth and Anderson never tell you *this*, however.

Question: A sample that is more than fifty thousand years old shouldn't have any measurable C-14. Coal, oil, and natural gas are supposed to be *millions* of years old; yet creationists say that some of them contain measurable amounts of C-14, enough to give them C-14 ages in the tens of thousands of years. How do you explain this?

Answer: Very simply. Radiocarbon dating doesn't work well on objects much older than twenty thousand years, because such objects have so little C-14 left that their beta radiation is swamped out by the background radiation of cosmic rays and potassium-40 (K-40) decay. Younger objects can easily be dated, because they still emit plenty of beta radiation, enough to be measured after the background radiation has been subtracted out of the total beta radiation. However, in either case, the background beta radiation has to be compensated for, and, in the older objects, the amount of C-14 they have left is less than the margin of error in measuring background radiation. As Hurley points out:

> Without rather special developmental work, it is not generally practicable to measure ages in excess of about twenty thousand years, because the radioactivity of the carbon becomes so slight that it is difficult to get an accurate measurement above background radiation. (p. 108)

Cosmic rays form beta radiation all the time; this is the radiation that turns N-14 to C-14 in the first place. K-40 decay also forms plenty of beta radiation. Stearns, Carroll, and Clark point out that ". . . this isotope [K-40] accounts for a large part of the normal background radiation that can be detected on the earth's surface" (p. 84). This radiation cannot be totally eliminated from the laboratory, so one could probably get a "radiocarbon" date of fifty thousand years from a pure carbon-free piece of tin. However, you now know why this fact doesn't at all invalidate radiocarbon dates of objects younger than twenty thousand years and is certainly no evidence for the notion that coals and oils might be no older than fifty thousand years.

Question: Creationists such as Cook (1966) claim that cosmic radiation is now forming C-14 in the atmosphere about one and one-third times faster than it is decaying. If we extrapolate backwards in time with the proper equations, we find that the earlier the historical period, the less C-14 the atmosphere had. If we ex-

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trapolate as far back as ten thousand years ago, we find the atmosphere would not have had any C-14 in it at all. If they are right, this means all C-14 ages greater than two or three thousand years need to be lowered drastically and that the earth can be no older than ten thousand years. How do you reply?

Answer: Yes, Cook is right that C-14 is forming today faster than it's decaying. However, the amount of C-14 has not been rising steadily as Cook maintains; instead, it has fluctuated up and down over the past ten thousand years. How do we know this? From radiocarbon dates taken from bristlecone pines.

There are two ways of dating wood from bristlecone pines: one can count rings or one can radiocarbon-date the wood. Since the tree ring counts have reliably dated some specimens of wood all the way back to 6200 BC, one can check out the C-14 dates against the tree-ring-count dates. Admittedly, this old wood comes from trees that have been dead for hundreds of years, but you don't have to have an 8,200-year-old bristlecone pine tree alive today to validly determine that sort of date. It is easy to correlate the inner rings of a younger living tree with the outer rings of an older dead tree. The correlation is possible because, in the Southwest region of the United States, the widths of tree rings vary from year to year with the rainfall, and trees all over the Southwest have the same pattern of variations.

When experts compare the tree-ring dates with the C-14 dates, they find that radiocarbon ages before 1000 BC are really too young—not too old as Cook maintains. For example, pieces of wood that date at about 6200 BC by tree-ring counts date at only 5400 BC by regular C-14 dating and 3900 BC by Cook's creationist revision of C-14 dating (as we see in the article, "Dating, Relative and Absolute," in the *Encyclopaedia Britannica*). So, despite creationist claims, C-14 before three thousand years ago was decaying faster than it was being formed and C-14 dating errs on the side of making objects from before 1000 BC look too *young,* not too old.

Question: But don't trees sometimes produce more than one growth ring per year? Wouldn't that spoil the tree-ring count?

Answer: If anything, the tree-ring sequence suffers far more from *missing* rings than from double rings. This means that the tree-ring dates would be slightly too young, not too old.

Of course, *some* species of tree tend to produce two or more growth rings per year. But other species produce scarcely any extra rings. Most of the tree-ring sequence is based on the bristlecone pine. This tree rarely produces even a trace of an extra ring; on the contrary, a typical bristlecone pine has up to 5 percent of its rings missing. Concerning the sequence of rings derived from the bristlecone pine, Ferguson says:

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> In certain species of conifers, especially those at lower elevations or in southern latitudes, one season's growth increment may be composed of two or more flushes of growth, each of which may strongly resemble an annual ring. Such multiple growth rings are extremely rare in bristlecone pines, however, and they are especially infrequent at the elevation and latitude (37° 20' N) of the sites being studied. In the growth-ring analyses of approximately one thousand trees in the White Mountains, we have, in fact, found no more than three or four occurrences of even incipient multiple growth layers. (p. 840)

In years of severe drought, a bristlecone pine may fail to grow a complete ring all the way around its perimeter; we may find the ring if we bore into the tree from one angle, but not from another. Hence at least some of the missing rings can be found. Even so, the missing rings are a far more serious problem than any double rings.

Other species of trees corroborate the work that Ferguson did with bristlecone pines. Before his work, the tree-ring sequence of the sequoias had been worked out back to 1250 BC. The archaeological ring sequence had been worked out back to 59 BC. The limber pine sequence had been worked out back to 25 BC. The radiocarbon dates and tree-ring dates of these other trees agree with those Ferguson got from the bristlecone pine. But even if he had had no other trees with which to work except the bristlecone pines, that evidence *alone* would have allowed him to determine the tree-ring chronology back to 6200 BC. (See Renfrew for more details.)

So, creationists who complain about double rings in their attempts to disprove C-14 dating are actually grasping at straws. If the Flood of Noah occurred around 3000 BC, as some creationists claim, then all the bristlecone pines would have to be less than five thousand years old. This would mean that eighty-two hundred years worth of tree rings had to form in five thousand years, which would mean that one-third of all the bristlecone pine rings would have to be extra rings. Creationists are forced into accepting such outlandish conclusions as these in order to jam the facts of nature into the time frame upon which their "scientific" creation model is based.

Question: Creationist Thomas G. Barnes has claimed that the earth's magnetic field is decaying exponentially with a half-life of fourteen hundred years. Not only does he consider this proof that the earth can be no older than ten thousand years but he also points out that a greater magnetic strength in the past would reduce C-14 dates. Now if the magnetic field several thousand years ago was indeed many times stronger than it is today, there would have been less cosmic radiation entering the atmosphere back then and less C-14 would have been produced. Therefore, any C-14 dates taken from objects of that time period would be too high. How do you answer him?

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Answer: Like Cook, Barnes looks at only part of the evidence. What he ignores is the great body of archaeological and geological data showing that the strength of the magnetic field has been fluctuating up and down for thousands of years and that it has reversed polarity many times in the geological past. So, when Barnes extrapolates ten thousand years into the past, he concludes that the magnetic field was nineteen times stronger in 4000 BC than it is today, when, actually, it was only half as intense then as now. This means that radiocarbon ages of objects from that time period will be too young, just as we saw from the bristlecone pine evidence.

Question: But how does one know that the magnetic field has fluctuated and reversed polarity? Aren't these just excuses scientists give in order to neutralize Barnes's claims?

Answer: The evidence for fluctuations and reversals of the magnetic field is quite solid. V. Bucha, a Czech geophysicist, has used archaeological artifacts made of baked clay to determine the strength of the earth's magnetic field when they were manufactured. He found that the earth's magnetic field was 1.5 times as strong as today around 1 AD, 1.6 times as strong around 400 BC, 0.8 times as strong around 2000 BC, and only 0.5 times as strong around 4000 BC. (See Bailey, Renfrew, and *Encyclopedia Britannica* for details.) In other words, it rose in intensity from 0.5 times its present value in 4000 BC to a peak of 1.6 times its present value in 400 BC, and it has been slowly declining since then. Even *before* the bristlecone pine calibration of C-14 dating was worked out by Ferguson, Bucha *predicted* that this change in the magnetic field would make radiocarbon dates too young.

> This idea [that the fluctuating magnetic field affects influx of cosmic rays, which in turn affects C-14 formation rates] has been taken up by the Czech geophysicist, V. Bucha, who has been able to determine, using samples of baked clay from archeological sites, what the intensity of the earth's magnetic field was at the time in question. Even before the tree-ring calibration data were available to them, he and the archeologist, Evzen Neustupny, were able to suggest how much this would affect the radiocarbon dates. (Renfrew, p. 76)

Not only that, but his predictions were confirmed in detail:

> There is a good correlation between the strength of the earth's magnetic field (as determined by Bucha) and the deviation of the atmospheric radiocarbon concentration from its normal value (as indicated by the tree-ring radiocarbon work). (Renfrew, p. 76)

So, once we know *all* the magnetic data, we see that it really supports the tree-ring

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calibration of C-14 dating, rather than the conclusions of Cook and Barnes.

As for the question of polarity reversals, plate tectonics can teach us much. It is a fact that new oceanic crust continually forms at the mid-oceanic ridges and spreads away from those ridges in opposite directions. When lava at the ridges hardens, it keeps a trace of the magnetism of the earth's magnetic field. Therefore, every time the magnetic field reverses itself, bands of paleomagnetism of reversed polarity show up on the ocean floor alternated with bands of normal polarity. These bands are thousands of kilometers long, they vary in width, they lie parallel, and the bands on either side of any given ridge form mirror images of each other. Thus it can be demonstrated that the magnetic field of the earth has reversed itself dozens of times throughout earth history.

Barnes, writing in 1973, ought to have known better than to quote the gropings and guesses of authors of the early sixties in an effort to debunk magnetic reversals. Before plate tectonics and continental drift became established in the mid-sixties, the known evidence for magnetic reversals was rather scanty, and geophysicists often tried to invent ingenious mechanisms with which to account for this evidence rather than believe in magnetic reversals. However, by 1973, sea floor spreading and magnetic reversals had been documented to the satisfaction of almost the entire scientific community. Yet, instead of seriously attempting to rebut them with up-to-date evidence, Barnes merely quoted the old guesses of authors who wrote before the facts were known. But, in spite of Barnes, paleomagnetism on the sea floor conclusively proves that the magnetic field of the earth oscillates in waves and even reverses itself on occasion. It has not been decaying exponentially as Barnes maintains.

Question: Does outside archaeological evidence confirm the C-14 dating method?

Answer: Yes. When we know the age of a sample through archaeology or historical sources, the C-14 method (as corrected by bristlecone pines) agrees with the age within the known margin of error. For instance, Egyptian artifacts can be dated both historically and by radiocarbon, and the results agree. At first, archaeologists used to complain that the C-14 method must be wrong, because it conflicted with well-established archaeological dates; but, as Renfrew has detailed, the archaeological dates were often based on false assumptions. One such assumption was that the megalith builders of western Europe learned the idea of megaliths from the near-eastern civilizations. As a result, archaeologists believed that the Western megalith-building cultures had to be younger than the Near-Eastern civilizations. Many archaeologists were skeptical when Ferguson's calibration with bristlecone pines was first published, because, according to his method, radiocarbon dates of the Western megaliths showed them to be much *older* than their Near-Eastern counterparts. However, as Renfrew demonstrated, the similarities between these Eastern and Western cultures are so superficial that

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the megalith builders of western Europe invented the idea of megaliths independently of the Near East. So, in the end, external evidence reconciles with and often confirms even controversial C-14 dates.

One of the most striking examples of different dating methods confirming each other is Stonehenge. C-14 dates show that Stonehenge was gradually built over the period from 1900 BC to 1500 BC, long before the Druids, who claimed Stonehenge as their creation, came to England. Astronomer Gerald S. Hawkins calculated with a computer what the heavens were like back in the second millennium BC, accounting for the precession of the equinoxes, and found that Stonehenge had many significant alignments with various extreme positions of the sun and moon (for example, the hellstone marked the point where the sun rose on the first day of summer). Stonehenge fits the heavens as they were almost four thousand years ago, not as they are today, thereby cross-verifying the C-14 dates.

Question: What specifically does C-14 dating show that creates problems for the creation model?

Answer: C-14 dates show that the last glaciation started to subside around twenty thousand years ago. But the young-earth creationists at ICR and elsewhere insist that, *if* an ice age occurred, it must have come and gone far less than ten thousand years ago, sometime after Noah's flood. Therefore, the only way creationists can hang on to their chronology is to poke all the holes they can into radiocarbon dating. However, as we have seen, it has survived their most ardent attacks.

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Creation-Evolution Debates: Who's Winning Them Now?

Frederick Edwords

The question of whether or not scientists should debate creationists is far from settled among those actively opposing creationist efforts. Though many support debates, many oppose them. It will be useful here to put forth the basic arguments on both sides of this question and then follow with a report on the results of the most recent public debates and lectures.

To Debate or Not to Debate

Two leaders in the effort to make an effective response to creationism have recently spoken out against the practice of debating. One is Dr. Maxine Singer, a leading biochemist at the National Cancer Institute. The other is Professor Steven Schafersman of the Department of Geology at Rice University and liaison for the Texas Committee of Correspondence on Evolution. They have individually raised some provocative points, which, when combined, make an impressive case against debating. The reasons are:

1. A debate implies a win-or-lose situation, which is not scientific.

2. A debate misleads people into thinking that creation and evolution are somehow equal in standing, that the scientific community is equally divided on the issue, and that the whole matter is far from being resolved scientifically.

3. Creationists wish to debate scientists, particularly well-known ones, in order to legitimize themselves and creationism in the eyes of the public. Thus the mere occurrence of such an event, regardless of the outcome, tends to make creationism seem more respectable.

4. When creationists claim that a given debate is about science and not religion, they imply that creationism is science and not religion. For a scientist to debate them on those terms is to concede a major part of the creationist case before the debate has even begun.

5. A debate suggests that the matter can easily be decided by the public within a couple of hours.

6. Debating is a creationist idea, and scientists play by the creationists' standards and on their terms when they cooperate with this activity, thereby allowing themselves to be manipulated toward creationist ends. The very fact that creationists, campus fundamentalist groups, and, recently, Jerry Falwell have collectively committed millions of dollars to promoting such debates should sound a

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warning that they understand that they will benefit regardless of the debate's outcome.

7. Public debates are actually political moves by creationists, not sincere efforts to argue or teach science. For, if creationists were really trying to be scientific, they would be stating their case before the scientific community instead of adopting a method common to charlatans, namely that of going to the public with claims of conspiracy and discrimination by the scientific community.

8. Debates are often publicity stunts for the benefit of the sponsoring fundamentalist campus groups or for the purpose of spreading creationist ideas. Debates, therefore, have been major vehicles for the growth of the creationist movement.

9. Debates are spectacles—not reasoned and fair examinations of both sides of the public controversy.

10. Debates accomplish little for science, since the issue is largely a matter of faith for many, no matter how much science is discussed.

11. Creationists often distort evidence in their debates and present persuasive but actually illogical and fallacious arguments. However, they do so in a manner that makes creationism appear plausible to a public poorly trained in the sciences. Yet, if the scientist points this out, the creationist charges him or her with insulting the audience and being patronizing. If creationists use distortions or falsehoods in their arguments, it is difficult to call them down for it without seeming discourteous or appearing to be engaging in *ad hominum* attacks on them. Yet, if one does not risk this, then such distortions or falsehoods will appear to be legitimate scientific arguments.

12. Doing well in a debate often requires that one "beat creationists at their own game," which often means compromising either science or one's integrity.

13. Preparation for such debates is time consuming and distracts greatly from more important scientific work.

Those speaking out in favor of debates include David H. Milne, a professor of biology and ecology at The Evergreen State College and a number of others who have had successful exchanges with creationists, including this writer. Our reasons for favoring properly handled debates are:

1. Many valid arguments against debating are now invalid, because so many debates have already taken place. If debating was ill advised, it never should have been done in the first place. But to stop debating now is to imply to the public that the creationists have the better case. Therefore the only solution is to debate the creationists and consistently do well in such encounters.

2. When creationists fail to find an opponent, this does not prevent the event from taking place. It merely means that the creationist will speak unopposed. In addition, the creationist will make much of the fact that his offers to debate were declined. This can have a negative effect on the public's view of science and scientists and can serve to validate creationist claims.

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3. Debates give science a free public platform, albeit diluted with the pseudoscience of creationism. As Milne declared after his first debate, "My audience was profoundly interested in the debate and more concerned and attentive throughout the entire three hours than was any fifty-minute class in all of my twelve years of teaching experience." Such debates, then, can become a valuable public-instruction tool when properly handled.

4. The public is entitled to feedback from the scientific community on this issue. Often it is only something such as a debate that can get scientists to deal directly with the general public. It would be better if this were not so, but, so long as this is the case, debates will have positive value.

5. Creationism will not go away by itself. It is a serious threat. Since winning debates has actually proved effective in slowing the creationist movement in some communities (examples will be provided later), it should be regarded as an effective tool for maintaining the integrity of science in the public schools.

6. To object to debates, while favoring lobbying and testifying at public hearings before politicians, is inconsistent. Such lobbying, testifying, witnessing in court cases, and the like is nothing other than engaging in debate. Often television and radio programs won't feature just one side of the issue. Therefore, in order to get broadcast media exposure for the scientific side, one must consent to a debate situation as well. So, clearly, debate is a regular part of this controversy.

7. With the overwhelming evidence in favor of evolution, scientists have little excuse for losing a debate. Furthermore, since the creationist "model" is so weak in so many places, a debate can be an excellent opportunity for exposing creationism for the pseudoscience it is. Much preparation is needed, of course, including a "renaissance" knowledge of science and a thorough understanding of creationism. Debates are not for the faint-hearted or ill-prepared. But those who debate well are providing a valuable service to the public and to science.

8. Though many in attendance at debates have their minds already made up, many do not. If these individuals "on the fence" are not reached with point-by-point answers to the creationist's arguments, they could easily by swayed into accepting at least a portion of the creationist errors. Furthermore, many who now accept creationism do so because they think their religion requires it. If they can be shown that creationism is not good science and not necessarily good religion, they might find it possible to accept evolution without denying their faith. But if all they hear is that accepting evolution is denying God, they may come to think that is the actual choice before them.

9. With so little evolution actually being taught in the public schools, and with the present diluting of textbooks, National Geographic television specials and creation-evolution debates are becoming major sources of public information on evolution. This is obviously deplorable, and something should be done about it. Meanwhile, those good at debate do their part to support evolution.

As you can see, there are significant arguments on both sides of the debating

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question. The airing of these arguments won't likely settle the issue but can help promote mutual respect between those with different methods of responding to creationists.

The Purdue Debate

Since the last quarter of 1981, those arguing for evolution have scored a number of significant victories over creationists in debate. It appears no longer necessary to say, "Creationists usually win their debates." That situation has changed, and the evolution side is now coming out on top.

One thing that has helped reverse the trend is the willingness of more debaters to devote time and study to understanding creationism. For example, Dr. Craig Nelson, who debated creationist Dr. Henry Morris at Purdue University on October 29, 1981, had extensively studied literature from the Institute for Creation Research. He had also had his biology students at the University of Indiana critique Dr. Morris's book, *The Scientific Case for Creationism*. This allowed him to challenge Dr. Morris on his flood geology arguments during the debate and to show how the earth couldn't possibly be a mere ten thousand years old. Dr. Morris, however claimed in rebuttal that discussion of the flood was bringing religion into the debate and that the age of the earth was not germane to the creation-evolution issue. This common creationist tactic of avoiding a firm defense of the weakest parts of the creation model didn't stop Dr. Nelson from coming back with more arguments against creationism. Dr. Nelson also presented evidence for evolution, particularly in reference to DNA and protein chemistry similarities between related animals. He also gave examples of transitional forms. An audience of over two thousand witnessed this debate.

The Tampa Debates

Doing well in a debate can mean much more than affecting a large audience, however. It can contribute toward reversing a creationist trend in a community as well. The best example of this is Dr. Ken Miller's debate against Dr. Morris in Tampa, Florida, on September 19, 1981. Prior to the debate, Dr. Miller checked with a Tampa scientist to see what the situation was locally. Miller wanted to be sure that nothing he did would make the public school situation there any worse. As it turned out, the local schools in Hillsborough County had already mandated the teaching of creationism in a "multimodel" approach. Therefore, Miller determined that nothing could make the situation worse, and he agreed to debate.

In his preparation, he contacted *Creation/Evolution* for information on the Paluxy footprints. Miller felt that in his first debate with Morris at Brown Uni-

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versity he hadn't handled that material as effectively as he would have liked. He had done well at Brown, winning handily, but believed that there is always room for improvement. (He had done so well, in fact, that creationists came the closest they have ever come to admitting defeat. *Acts & Facts* declared Dr. Miller to be "the most effective evolutionist debater Dr. Morris has encountered to date.")

After *Creation/Evolution* supplied him with the information he needed, Miller was ready to face Dr. Morris and the capacity crowd that turned out for the event. There were seventeen hundred who jammed the Jefferson High School auditorium and cafeteria, while several hundred had to be turned away. The debate was covered by six Tampa area television channels and seven radio stations, one of which broadcast the entire debate live. Another station broadcast a tape of the debate later. Area newspapers, including the Tampa *Tribune*, covered the debate quite extensively. A number of local and state school officials were in the audience. It was clearly a hot issue in the community.

Morris, who spoke first, began by claiming that the Bible, the age of the earth, and flood geology had nothing to do with the issue. He then gave the usual creationist presentation on the second law of thermodynamics, the absence of transitional forms in the fossil record, and the difference between "horizontal" and "vertical" evolution. He added his more recent arguments about creation scientists of the past, such as Kepler and Faraday.

Miller concentrated his attack on flood geology and the young earth theory. He argued the significance of starlight traveling from galaxies over ten thousand light years away. He also presented a number of slides of transitional forms, such as the mammal-like reptiles, the horse series, the elephant series, and the nautiloids. In arguing for evolution, he pointed out the genetic similarities between humans and the apes. Dr. Miller also made it clear that the creationist position was actually biblically, rather than scientifically, based and that, as a Catholic, he found the suggestion offensive that evolution was atheism. During the rebuttals and question-and-answer period, Dr. Miller dealt with the second-law argument and the Paluxy River footprints. On the latter, he quoted extensively from creationist geologist Berney Neufeld, who rejects the footprint evidence. Dr. Morris expressed bewilderment that his colleague Neufeld would come out against the prints and suggested that Neufeld might have some personal, emotional reason for doing so, perhaps related to infighting in creationist circles.

When ICR's *Acts & Facts* reported on the debate, it stated that the outcome "seemed to materially strengthen the creationist position in the Tampa area." As it turned out, however, the reverse was true. This became clear when Dr. Miller went to Tampa again, this time to debate Duane Gish on March 21, 1982. Because of the big turnout the previous time, the sponsoring fundamentalist group decided to sell tickets (at two dollars each and twenty-five dollars for a front row seat!). When John Betz, a professor of biology at the University of South Florida, bought his ticket at a religious bookstore, he asked the clerk how he

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thought the debate would go. The clerk replied, "Well, the creationist last time got beat—he didn't do such a good job. But Duane Gish is coming this time, and this time it'll be different!"

It was different. The television stations and newspapers weren't interested. The school board had recently put a hold on implementing the creation-science curriculum, and only three hundred people showed up for the debate. Apparently the people of Tampa had become a bit bored with the issue. Of course, the Arkansas court decision had come between these two debates, which probably made the biggest difference. But teachers had informed Dr. Miller previously of how great an impact his debate with Morris had in helping them in their efforts to combat creationism.

But now Miller was facing Gish (whom he had faced only once before). Gish used the usual creationist debate arguments, particularly those linking the gaps in the fossil record and the absence of transitional fossils. Miller focused again on the theories of the worldwide flood and the young earth. He also predicted that Gish would not defend his model, and this prediction came true. Miller presented quotes from Henry Morris's writings that declared creationism to be a science and quotes from Gish's writing that said creationism was *not* science. After this he suggested that maybe the next debate should feature Morris arguing with Gish on this point until it is settled.

After attacking creationism, Miller defended evolution. He answered Gish's arguments against *Archaeopteryx* and *Ichthyostega* being transitional fossils. He then quoted from Gish's paper on the mammal-like reptiles and showed how it contained rudimentary errors (such as misrepresenting the position of the middle-ear bones in reptiles and in saying that the columella connects the eardrum to the tympanum when actually the eardrum *is* the tympanum). Finally, he showed how the probability calculations against evolution used by Gish were based on faulty premises. The audience appeared surprised that Gish had made so many mistakes in his speaking and writing.

Since Miller had presented a slide series on *Triceratops*, showing how it evolved from *Monoclonius* which evolved from *Protoceratops*, Dr. Gish argued that *Monoclonius did not* show any incipient horns that wer precursors to the horns on *Triceratops*. He declared that Dr. Miller's slide was in error. But Miller rebutted by reading word-for-word from a leading text on the evolution of this dinosaur. The text even used Gish's words, "incipient horns," declaring their existence, complete with illustrations. Miller then handed this material to Gish and suggested that he study up before the next debate, causing the audience to roar with laughter.

Dr. Gish used a humorous caricature drawing of a cow evolving from a whale; Dr. Miller came back with solid data supporting the evolution of whales from land mammals. There were other thrusts and parries, but, by the time the question-and-answer period came, Gish was rather quiet. He even made a stab at

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supporting "progressive creation," the position that the creator "created" on a number of occasions over billions of years. But Miller quoted Henry Morris on the evils of "progressive creation" and jokingly told Gish that he would inform Dr. Morris of this compromise and get Gish into trouble when he went home.

Dr. Miller is now preparing a typescript of the entire debate, together with copies of the slides he used, so that persons debating creationists can benefit in the future. Since creationists compare notes, there is no harm in their debate opponents doing so as well.

The Guelph Debate

Another debate script that is available is of my debate with Dr. Gish at the University of Guelph in Ontario, Canada, on February 2, 1982. In this debate, I began by pointing out the disagreements among creationists on whether creation is or is not science. I then spelled out the "strictly scientific" creation model, as it appeared in the Arkansas law. Using the Arkansas creation model as an outline, I then presented evidence against each part of it. As part of my attack on this model, I spelled out the evidence for evolution, particularly as it relates to descent with modification, beneficial mutations, natural selection, and transitional forms. I also argued that the creationist acceptance of "horizontal" or "micro" evolution, which allows for "variations within created kinds," actually puts creationists uncomfortably (for them) closer to the evolutionary camp. I concluded by showing that creationists cannot agree on what to do with *Homo erectus* because it is so transitional between ape and human.

Dr. Gish had very little to say against these arguments. He ignored most of them and attempted to answer the others by quoting "leading scientists" who appeared to say the opposite. This strategy by Gish didn't appear to move those in the audience, however, since they seemed to want evidence rather than quotations.

The proof that this debate was indeed a "win" for evolution was evidenced in the newspaper accounts that followed the event. The Guelph *Daily Mercury* stated it mildly: "Both scholars exchanged broadsides during the debate, and, although Gish was seen to be limping out of the hall, there were no casualties." But the *Ontarion*, the university student newspaper, was more bold. In an article headlined "Edwords Goes Ape on Gish," the paper declared:

> As the arguments unfolded . . . it became apparent that Edwords was presenting evidence in support of his case, while systematically attacking creationist principles, and [that] Gish's presentation was almost exclusively based on problems with the evolution model. It was anti-evolutionist, not pro-creationist. Much of Gish's "evidence" was badly out of date, and some of it consisted of work that was in disrepute from the time of its publication.

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Edwords was able to counter the bulk of the creationist argument convincingly and with ease, and, in the absence of any comprehensive pro-creationist argument from Gish, the humanist looked to have got the better of the exchange.

The Tucson Debate

The slides of *Triceratops* evolution which I used seemed to have impressed the audience the most, so I immediately made them available to Drs. Ken Miller and David Milne when they debated Drs. Morris and Gish at the University of Arizona in Tucson on February 12, Darwin's 173rd birthday. (These same slides would later haunt Gish in other debates that followed, including Tampa.)

The Tucson debate was billed as a "Creation-Evolution Superbowl," because it involved leading debaters on both sides. A capacity crowd of two thousand attended the event and witnessed a very clear defeat of the creationist side.

Dr. Milne spoke first. He showed the major predictions of evolutionary theory and how the evidence bore them out. He then explained the intermediate characteristics of several important fossils. On one side of the stage, Milne had set up three large drawing tablets. The first showed the fore-limb of a modern bird, the second was blank, and the third showed the limb of a small coelurosaurian dinosaur. Dr. Gish was challenged to guuss at an acceptable intermediate form between the two, one that would satisfy his criteria for a "true transitional form," and to draw it on the blank tablet. Neither Dr. Gish nor Dr. Morris would put their claims on paper. Had they, they would have found that the form the limb would have to take in order to be midway between the coelurosaur and the modern bird is exactly the form of the limb of *Archaeopteryx*, the very fossil creationists deny to be transitional. The fact that the two creationists would not commit themselves to a testable statement about transitional forms disappointed some of their followers in the audience.

Dr. Milne concluded his talk with examples of poorly "designed" structures in living animals and questioned how parasites fit into the notion of creation by a loving creator.

Dr. Morris followed and gave the same arguments about probabilities and the second law of thermodynamics that he had given in previous debates. Then it was Dr. Miller's turn. Miller gave thirty minutes of rapid-fire attacks on flood geology, the young earth, and other aspects of the creation model. When he finished, he was greeted by loud applause.

Dr. Gish spoke next. He delighted the audience with his clever jokes about evolution, showed the slide of a chimpanzee that he claimed was his grandson, showed his amusing cow-into-whale slide, and quipped his way from Nebraska man and Piltdown to Fred Hoyle (the scientist who has recently denied evolution). Gish was masterful and funny, and, when he finished, he was greeted by a

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thunder of applause.

Milne in his rebuttal challenged Gish with about ten transitional forms he had on slides and asked Gish to explain why these were denied by creationists. Milne also asked Gish why he wouldn't go over to the tablet and draw the transitional structure that would meet his approval.

Morris, in his rebuttal, complained that the two evolutionary scientists were attacking the *biblical* creation model, not the scientific one. This evoked groans of disappointment toward Morris from the creationist rooting section. Morris then went on to argue that evolution could not be God's method of creation because evolution was too cruel a system.

In Miller's rebuttal, the audience was reminded of a basic question: How can the fossil record look so much like evidence for evolution unless it really is? They were also reminded that Morris and Gish had not addressed this problem. Miller then answered Gish's claims about Nebraska man and Piltdown and concluded with a slide showing the variation of human cranial capacity with time.

Instead of answering with evidence any of Miller's and Milne's challenges, Gish used his rebuttal time to quote scientific "authorities" who seemed to deny that transitional forms exist. Many in the audience later reported that they felt Gish had backed off from the clear challenge to his claims about gaps in the fossil record. Gish also argued that Miller's and Milne's approach "resembled a head-on view of a longhorn steer—a point here, a point there, and a lot of bull in between."

The question-and-answer period brought out discussions of the Arkansas decision, the Paluxy River prints, and the second law of thermodynamics. Milne produced a dazzling set of slides on the Paluxy River to show how the human footprints were hoaxes and mistakes, and Miller presented seven slides on the second law. At this point, those in the audience who supported evolution began cheering and whistling defiantly, and Gish's answers were met with boos and catcalls. (The creationists, writing later in *Acts & Facts*, justifiably complained about this audience behavior, but they implied that the fault was due to so many "humanists" being in the audience. The actual humanist presence happened to be rather small and scattered and, thus, could not have been a major factor.)

Other questions were asked and answered, but, when the creationist moderator started to ask the final question, Dr. Gish began shouting for recognition, claiming a point of "personal privilege." The moderator was visibly annoyed and tried to restrain Dr. Gish. The two began yelling at each other for what seemed like a full minute, amid shouts of "shut up you turkey!" and "obey the rules" directed at Gish from the audience. A microphone was almost knocked over in the brief pandemonium on stage.

Clearly, this was not your typical dignified academic debate. Yet the same criterion for judging the outcome applies. In terms of argument and evidence, it was plain by the debate's end that Miller and Milne had carried the day. Even

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many of the creationists in the audience seemed to realize this.

An effort is being made to secure for distribution the video tapes that were made of this event.

The Ann Arbor Debate

Dr. C. Loring Brace is a leading physical anthropologist, who is also well-versed in the creationist arguments. He debated Gish at the University of Michigan in Ann Arbor on March 17. In that debate, Brace chose a strategy considerably different from that of other successful debaters. Instead of covering the entire waterfront of the controversy so as to match the similar effort by Dr. Gish, Brace concentrated on his own scientific specialty, the human fossil record. He zeroed in on Gish's misrepresentations of the literature in this area, exposing misquotations, misunderstandings, ignored data, use of outdated material, and other errors and distortions that have appeared in Dr. Gish's writings on the subject. Many of the quotes from Gish's books were made into slides. The results were effective and diminished much of Gish's credibility.

In a last-ditch effort to save his case, Gish attempted a clever maneuver in his final five-minute rebuttal. He appealed to the crowd and said, "Now I want you to stand up if you believe that creation should be taught in the schools." The moderator, however, stepped in and told Dr. Gish that this was inappropriate.

The Charlottesville Debate

On March 22, Duane Gish came to the University of Virginia to debate two biology professors, Dr. Jerry O. Wolff and Dr. James Murray. Again he was met by prepared debaters who again were armed with the *Triceratops* slide series and information from Ken Miller and myself.

The debate proceeded in a rather subdued fashion at first, and then Drs. Wolff and Murray made their strongest points in the rebuttal. Dr. Gish had declared that there were no transitional forms; the biologists responded by presenting the *Triceratops* series and series of flying squirrels to bats, polar bears through otters, beavers, seals, and dolphins, and *Australopithecines* to modern humans. They also had responses to Gish's arguments on the improbability of life evolving, the second law, and the age of the earth. They were able to get Dr. Gish to state that animals were divided into discrete kinds, which show no overlap. They then showed a slide of six skulls—two bats, two prosimians, and two insectivores—and asked Gish to put them into "kinds." The audience could see how similar these three groups were and how hard it would be to make proper divisions. Gish refused to cooperate.

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Because Dr. Gish gave his standard humorous presentation, most of the comments heard afterwards were that creationists have no data. On the other hand, Drs. Wolff and Murray presented nothing but data throughout their part of the debate.

The New Britain Debate

At Central Connecticut State College in New Britain, Connecticut, Dr. Gish debated Dr. Michael Alan Park, associate professor of anthropology, on April 1.

Park, who was well prepared, began by defining science and distinguishing it from pseudoscience and then carried this theme throughout his talks by pointing out the nonscientific nature of creationist claims. He exposed the fallacy used by creationists of thinking that, by destroying Theory A, one has automatically supported Theory B. Trying to discredit evolution will not lend credit to creation. Creation must be proved on its own merits.

After these points were made, Park explained evolution and its evidence and showed how the evidence was mutually supportive. He also showed how the evidence supported the *predictions* of evolution. In the process he covered the age of the universe and the earth, answered the claims about gaps in the fossil record, and explained punctuated equilibrium theory.

To be effective, he had to do what Dr. Gish would not: he had to state the creation model. One aspect of the model requires a young earth, which in turn requires the "appearance of age at the instant of creation." So, Dr. Park covered this material. He also pointed out the root religious nature of creationism.

The debate became heated, but, in the end, the result was positive for evolution.

The Berkeley Lecture

I had gotten the word a bit late that Dr. Gish was going to speak unopposed at the University of California at Berkeley because he had been unable to find an opponent. I therefore volunteered myself, agreeing to pay my own airfare to get there. Dr. Tom Jukes of the Department of Biophysics and Medical Physics at Berkeley immediately began negotiating with the Chinese Christian Church in Oakland, which was cosponsoring the event with a campus group. However, they turned the challenge down in favor of Gish speaking alone. Their main reason for doing so was because they had already printed seven thousand leaflets announcing the Gish appearance as a lecture.

Whatever power this argument may have had was negated by the fact that the leaflet contained a gross error about Dr. Gish's credentials. It said, "Dr. Gish

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. . . spent eighteen years as a faculty member at Cornell Medical School. . . ." But according to *American Men and Women of Science*, Dr. Gish was at Cornell two years as a postdoctoral fellow and one year as an assistant professor. Since this error was discovered in time, the leaflets should have been reprinted. And that would have allowed for billing the event as a debate.

However, the Chinese Christian Church would have none of this, and so Dr. Gish came to lecture. In an effort to balance the presentation, faculty members, led by Tom Jukes, composed a leaflet of their own challenging creationist claims and distributed it prior to the lecture. A Christian student group produced their own leaflet, entitled "Would God Lie to You?" which was strongly critical of Dr. Gish and cited the responses of misquoted scientists that appeared in *Creation/Evolution* (issue VI). The leaflet's conclusion was that Dr. Gish was doing the devil's work.

By the time Dr. Gish approached the podium to speak, he was aware that his sizable audience was mostly hostile. Gish spoke for two hours before accepting the call for questions. The audience stayed throughout the whole performance so that they could raise the issues that they felt were important. One questioner, Steve Ogresky, asked what evidence there was for Dr. Morris's claims that battles between good and bad angels had power over natural processes and that UFOs were piloted by devils. Gish's response was to ask, "Are you Tom Jukes?" He then passed off the question as an attack on his piety and went to the next question.

At one point, anthropologist Tim White countered Gish's claim that there is no evidence to support human evolution. He did so by bringing a skull cast of *Homo erectus* onto the stage, telling Gish, "That's your ancestor." Gish responded by declaring the skull to be that of an ape. But White was ready for him. He signaled to a colleague who marched up with a gorilla skull to show Gish the difference. It was some time before the audience stopped laughing. Gish repeatedly chided the audience for its behavior but was chided in return for insulting his listeners' intelligence with this theories.

Dr. Gish later declared that the situation at Berkeley "was totally unexpected." He added, "The behavior was the worst I've ever encountered."

Though many in the audience were clearly rude, others raised legitimate issues. Furthermore, this lecture did not represent the first time Dr. Gish had faced challenges in recent months when speaking unopposed. His April 4 lecture at the University of Massachusetts in Amherst (which I also volunteered to turn into a debate) netted a similar result, though without the rudeness. There Dr. Laurie Godfrey read from science sources that Dr. Gish had misquoted, and other members of the audience were equally critical. Furthermore, just before my debate with him in Guelph, Dr. Gish addressed a Canadian high school audience and found that the students there also asked him a number of difficult questions.

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Another Approach

All this means that, with preparation and an understanding of the issues, those supporting evolution have been able to effectively challenge creationists at the podium. And with increasing dissemination of the sort of answers provided by *Creation/Evolution*, more people, including members of the audience, have been able to raise the important questions.

But is the present debating style the best way to go, even with the current successes? Not necessarily. Professor Theodore Steegmann, Jr., chairman of the Department of Anthropology at the State University of New York at Buffalo, has perhaps a better idea. He feels that the present format of debates allows creationists to skip all over the waterfront of the issue and thereby avoid the risk of being cornered on a specific point. It is too easy for creationists to either stump their opponents with facts outside their opponents' specialties or to change the subject when the going gets rough. Therefore, Steegmann proposes that scientists stop playing the game by creationists' rules and set the rules themselves. This can be done by challenging creationists to debate instead of being challenged by them.

However, when a scientist challenges a creationist to debate, the debate must be set up differently. Instead of the topic being general, such as "Resolved: Evolution is a better scientific model than creation," it should be more specific. One example might be, "Resolved: *Homo erectus* was neither a hominid nor ancestral to modern humans." Another could be, "Resolved: It is probable that the Grand Canyon was formed in a single year by a worldwide flood." The advantage of such an approach is that it would force creationists to bring their evidence to bear on a single key issue. It would force them to make their case. In addition, it would prevent the debate from becoming a show or circus.

With such a format, the creationists could bring in their best debater on the topic to be debated and have him face off against a scientific expert. The expert would essentially present what would amount to a freshman-level lecture on why scientists believe as they do about the topic and why they reject the creationist explanation. The creationist would challenge the scientific conclusions and offer his own. Such a format would reveal who had the facts and the best case.

It would seem that, if creationists are sincere in their claims that creationism is a better scientific explanation than evolution, they would welcome such a challenge. But if creationists are either not sincere or lack confidence in their data, they would turn down a debate such as this; if they did turn it down, the public would have a right to know about it.

This approach, then, would force creationists sooner or later to state and defend their model, make a scientific case for it, and argue from the evidence. If they proved unable or unwilling to do this, they would soon find that debating is a poor way to spread their ideas. They are finding this out now, even with the present flawed debating format. But a more scientific format would settle the issue.

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News Briefs

The Louisiana case over the constitutionality of a two-model creation-evolution law, which passed in that state in July 1981, has gone through a number of transformations and postponements. The result at the present time is that the creationist case has been thrown out of federal court and the way has been opened for the ACLU case to be reentered.

In order to understand what these results mean, however, it will be necessary to retrace the history of this case.

On December 2, 1981, a group of creationists filed suit in the U.S. District Court in Baton Rouge, Louisiana, demanding a declaratory judgment that the Louisiana creation law was constitutional and should be enforced. The very next day, the ACLU filed suit in the U.S. District Court in New Orleans against the creation law, demanding that it be declared unconstitutional. Once both cases were filed, the opposing attorneys began to work on getting each other's cases thrown out of court.

For a while there was talk of combining the two cases, but then, on March 18 of this year, the ACLU case was set aside pending the outcome of the creationist case that had been filed first. A date was then set for the creationist suit to go to court, and the ACLU was brought in to defend the Orleans School Board, which was a defendant in the suit. However, on June 28, the creationist case was thrown out of court because it involved no *federal* question. The creationists were not claiming that any constitutional rights were being violated by the nonenforcement of the creationist law, and, thus, the judge held that federal court was inappropriate. He determined that, because the creaionists were suing to get a state agency to obey a state law, the case should be tried in a state court.

This ruling has reopened the doors for the original ACLU suit, which was set aside on March 18. A hearing for an ACLU motion to reopen their federal case is set for August 11. Meanwhile, if the creationists still wish to pursue their case, they will have to enter it into a state court.

Prior to these most recent rulings, there had been many depositions taken on both sides, a large number of witnesses gathered, and much hoopla in the Louisiana press. The key figures in the creationist suit were Wendell Bird of the Institute for Creation Research and Thomas Anderson of Indio, California (substituting for John Whitehead of Manassas, Virginia). The two California lawyers had been deputized by the Louisiana attorney general. The key figures in the ACLU suit were and still are ACLU attorney Jack Novik, who figured prominently in the Arkansas case, and Jay Topkis, an ACLU cooperating attorney from a leading New York law firm.

All the creationist bills of 1982 have failed, largely due to the Arkansas decision,

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but also because of the effective work of local grass-roots organizations. Bills failed in eleven states: Arizona, Florida, Georgia, Iowa, Kansas, Maryland, Mississippi, Missouri, South Carolina, South Dakota, and West Virginia. In the Maryland example, the newest Ellwanger model bill was used and the Maryland Attorney General issued a comprehensive opinion arguing that Ellwanger's new wording did not render his unconstitutional effort constitutional.

The creationist school board push is also losing steam. For example, in Michigan the State Board of Education adopted on March 10 a strong resolution calling for an end to "teaching creationism or any course in religion." In Clover Park, Washington, a suburb of Tacoma, the local school board voted to remove creationism from its schools after the ACLU threatened to bring suit and the school district's attorney prepared an opinion against creationism. In West Bend, Wisconsin, the local school board voted four to three on April 26 to ban creationism. The three dissenting board members had wanted an even stronger anti-creationist resolution, one that would ban it from *all* parts of the curriculum. Then, on May 24, the Greenfield, Wisconsin School Board passed an anti-creationist resolution in advance of any creationist push so as to avoid the controversy that had occurred in West Bend. Later that same week, on May 27, creationists in Port Washington, Wisconsin, asked their local school board to institute the creationist two-model idea. Not only were they turned down, but a resolution was passed barring such instruction. And now, after four months of debate, the school board in Medford, Oregon, has rejected creationist efforts.

Jerry Falwell may have spoken too soon after a state board of education teachers visiting committee voted on April 8 to approve for certification as Virginia public school teachers biology graduates of Falwell's Liberty Baptist College. For after this approval was given, Falwell boasted in a television sermon and in a *Washington Post* interview that now creationism could be taught in Virginia public schools and in the public schools of the thirty-five states that recognize Virginia certification. On television, he declared, "So now we, with God's help, want to see hundreds of our graduates go out into the classrooms teaching creationism. Of course, they'll be teaching evolution, but teaching why it's invalid and why it's foolish, and then showing the proper way and correct approach to the origin of the species." As a result of such statements, the Board of Education teachers advisory committee met on May 21 and voted unanimously to deny teacher certification to Liberty Baptist College graduates in biology. The full Board of Education for the state will likely confirm the committee vote in July, since no advisory committee recommendation has ever been reversed. The reason the original teachers visiting committee voted approval was because Liberty Baptist school representatives insisted that the college presented "both sides" by also teaching standard evolutionary biology.

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Recently Held Symposia

On April 16 and 17, the State University of New York at Buffalo hosted "Science, the Bible, and Darwin: An International Symposium to Honor the Centennial of Charles Darwin's Death." The symposium was sponsored by *Free Inquiry* magazine and the Departments of Philosophy, Biology, Anthropology, and Geology at the university. Speakers included Philip Appleman, Sol Tax, H. James Birx, Gerald Larue, Michael Novak, Joseph Fletcher, Antony Flew, Kai Nielsen, Garrett Hardin, William V. Mayer, and "The Amazing Randi." The entire program was under the direction of Paul Kurtz, who opened the activities by welcoming none other than Charles Darwin himself to the podium (played by Professor Clyde Herreid of the SUNY Department of Biology). Some of the topics covered were "Charles Darwin and His Influence," "The Bible Re-examined: A Scholarly Critique," "Darwin, Evolution, and Creationism," and "Magic and Religion." This last presentation featured magician James Randi lecturing on the connections between magic, religion, and pseudoscience. The entire two-day series of panels was free and open to the public.

On April 17, Illinois State University at Normal hosted "A Symposium on Scientific Creationism, Evolution, and Science Education." The program was put on by Boyce Drummond of the biology department and Sherman Kanagy of the physics department. Featured speakers were creationists Harold Brown of the Department of Philosophy at Northern Illinois University at Dekalb and John Cunningham of the Department of Science at Maranatha Baptist Bible College in Watertown, Wisconsin, and evolutionists Charles Thaxton of the Foundation for Thought and Ethics in Richardson, Texas, and Craig Nelson of the Department of Biology at Indiana University in Bloomington. Each speaker gave a separate talk on an aspect of the controversy and then the four joined together and concluded with a panel discussion. Topics discussed included the legal and educational issues, the nature of science, the origin of life, catastrophism, and the geologic record, and the difficult problems faced by science teachers as a result of this controversy.

On April 19, the actual centennial of Darwin's death, Canisius College in Buffalo, New York, presented "Darwin and Evolution: A Centennial Tribute." H. James Birx chaired the symposium, which featured, among others, papers on "The Evolution of the Idea of Evolution," "Sociobiology and Darwinism: Critical Reflections," "The Evolving Darwinian Devolution," "Darwin's Impact on Theories of Human Crime."

On May 8, San Jose State University, the California Science Teachers Association, the Elementary School Science Association, and Sigma Xi sponsored "Evolution: A Century After Darwin." Topics covered included evolutionary geology, chronometric dating, chemical evolution, the evolution of oxygen, the genetic bases of evolution, and human evolution. Special problems covered were the teaching of evolution in high schools and the social impact of evolution.

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